# Chapter 5 – Sampling Protocols

The development and implementation of protocols and standard operating procedures will take several years. We expect to implement 16 protocols by 2009 (Table 5.1) and we have thus far completed Protocol Development Summaries (PDS) for 12 of these planned protocols (Supplemental Document 7). Each PDS provides a summary of the justification, objectives, monitoring questions, basic approach for monitoring, and development schedule. In several cases, Vital Signs have been bundled in to a single protocol for efficient monitoring.

The content of all protocols will closely follow recommendations of Oakley et al. (2003). Each protocol will be a stand-alone document that will be attached as a supplement to this monitoring plan.

As a quick reference, we have summarized the initial protocols in Table 5.2. The objectives and questions are spelled out in more detail in the PDS documents and will be refined even further in the completed protocols. Objectives and questions evolve and become more refined as each protocol is developed because additional information may be uncovered, past data analyzed, and logistical and financial constraints better understood. Each protocol is being developed by a lead investigator from the Network and a subject-matter expert from a university or other federal agency. Our multi-disciplinary team approach to developing several protocols was further explained in Chapter 4 as part of the overall design of the program.

In summer 2006 we implemented five protocols after in-house and external peer review. These initial protocols were: water quality of large rivers, water quality of inland lakes, diatoms, amphibians, and bioaccumulative contaminants. The methods for each protocol appear sound though at least one protocol will undergo major change for 2007 (inland lakes), one is still provisional pending data analysis (amphibians), and an additional species must be adopted for bioaccumulative contaminants to expand this program to two more parks.

In summer 2007 we will implement three more protocols in the field: terrestrial plants, land birds, and both coarse and fine-scale land cover/land use. We also expect to implement the climate/weather protocol, which primarily involves mining data from partner programs and making it readily accessible. This later protocol is awaiting data mining efforts that are occurring at a national scale.

We have not predicted protocol development beyond 2009, although we will continue to consider how to add Vital Signs efficiently and effectively to these protocols and/or develop new protocols if time and funding permit.

**Table 5.1.** Development and implementation schedule for 16 protocols encompassing 21 Vital Signs selected for monitoring by the Great Lakes Inventory and Monitoring Network.

| | | | Year[2] | | | |
|---|---|---|---|---|---|---|
| **Protocol** | **PDS[1]** | **Vital Sign** | **2006** | **2007** | **2008** | **2009** |
| Climate and Weather | YES | Weather | DB | **X** | | |
| Air Quality | YES | Air Quality | DB | DB | **X** | |
| Water Quality<br>- Inland Lakes<br>- Large Rivers | YES (2) | Core Water Quality Suite | x | x | **X** | |
| | | Water Level Fluctuations | x | x | **X** | |
| | | Advanced Water Quality Suite | x | x | **X** | |
| Diatoms | YES | Diatoms | x | x | **X** | |
| Water Quality<br>- Wadeable Streams | YES | Core Water Quality Suite | PD | PD | **X** | |
| | | Water Level Fluctuations | PD | PD | **X** | |
| | | Advanced Water Quality Suite | PD | PD | **X** | |
| Fish | NO | Fish Communities | | PD | PD | x |
| Aquatic Nuisance Species | NO | Plant and Animal Exotics | PD | PD | x | **X** |
| Invasive Plants | NO | | PD | PD | x | **X** |
| Wetlands | NO | Aquatic and Wetland Plant Communities | | PD | PD | x |
| Land Cover/Land Use<br>- Coarse Scale<br>- Fine Scale | YES (2) | Land Cover/Use Coarse Scale | PD | x | **X** | |
| | | Land Cover/Use Fine Scale | PD | x | **X** | |
| | | Stream Dynamics | PD | x | **X** | |
| Terrestrial Vegetation | YES | Terrestrial Plants | PD | x | **X** | |
| | | Problem Species | PD | x | **X** | |
| | | Terrestrial Pests and Pathogens | PD | x | **X** | |
| | | Succession | PD | x | **X** | |
| | | Soils | PD | x | **X** | |
| Landbirds | YES | Bird Communities | PD | x | **X** | |
| Bioaccumulative Contaminants | YES | Trophic Bioaccumulation | x | x | **X** | |
| | | Species Health, Growth and Reproductive Success | x | x | **X** | |
| Amphibians | YES | Amphibians and Reptiles | x | x | **X** | |

1 = Protocol Development Summary. If YES, then a PDS is completed and included in Supplemental Document 7.

2 = DB = database development; PD = protocol development; x = pilot year; X = full implementation.

**Table 5.2.** Vital Signs, objectives, and some monitoring questions for 12 protocols currently being developed for implementation by the Great Lakes Network between 2006 and 2009 (see Supplemental Document 7 for further details). We expect to add four more protocols in future years (Table 5.1).

| Protocol | Vital Sign(s) | Objective | Monitoring Questions |
|---|---|---|---|
| Climate and Weather | • Weather | Provide baseline data and continuously updated data sets to facilitate the detection of regional climatic change in the western Great Lakes region and contribute to an understanding of this driver on other Vital Signs and ecosystems. | o Has the climate of the western Great Lakes region changed significantly from that of past decades or past centuries?<br>o Do these changes in climate warrant specific research or management actions to monitor or predict their effects on natural resources and other Vital Signs? |
| Air Quality | • Air Quality | Acquire, archive, analyze, and report on the air quality data collected by national and state agencies across the Great Lakes Network to track absolute changes as well as contribute to an understanding of this stressor on other Vital Signs and ecosystems. | o Does deposition of target airborne contaminants change through time?<br>o What are the changes in air quality over time?<br>o Do changes in air quality vary among parks within the Network? |
| Water Quality (3 protocols)<br>• Large Rivers<br>• Inland Lakes<br>• Wadeable Streams | • Core Water Quality Suite<br>• Advanced Water Quality Suite<br>• Water Level Fluctuations<br>• Benthic Invertebrates (wadeable streams) | Monitor water quality using methods comparable to state and national monitoring efforts such that trends will be detected. Compare trends in parks' waterbodies with trends occurring at broader spatial scales. | o What is the direction and magnitude of change of select water quality variables in individual waterbodies?<br>o Are similar ecological trends occurring across the park, across all GLKN parks, across the region?<br>o What is the direction and magnitude of change in select biotic indicator taxa? |
| Diatoms | • Diatoms<br>• Advanced Water Quality Suite | Monitor diatom species composition in select waterbodies to contribute to an understanding of water quality changes over time. | o What is the ecological status of this lake in relation to historical (last 150 years) environmental change noted in regional sediment cores?<br>o What is the direction and magnitude of change in select water quality variables in individual waterbodies?<br>o Are similar trends occurring across the park, across all GLKN parks, or across the region? |

**Table 5.2.** Protocol objectives and monitoring questions, continued.

| Protocol | Vital Sign(s) | Objective | Monitoring Questions |
|---|---|---|---|
| Land Cover/Land Use (2 protocols)<br>• Coarse Scale<br>• Fine Scale | • Land Cover/Use Coarse Scale<br>• Land Cover/Use Fine Scale | Monitor changes in land cover and land use at several scales to document absolute changes, as well as to provide context for analysis of results of other Vital Signs monitoring. | o What are the changes in area and shape in urban, agricultural, and other areas dominated by human land use within a defined monitoring region for each park?<br>o How has human population density, measured either by population or an index such as buildings, changed in each monitoring region?<br>o What are the changes in select variables (e.g., road density, impervious surface, amount of wetland, habitat fragmentation) within and adjacent to each park? |
| Terrestrial Vegetation | • Terrestrial Plants<br>• Problem Species<br>• Terrestrial Pests and Pathogens<br>• Succession<br>• Soils | Monitor terrestrial vegetation to document changes due to a variety of natural and anthropogenic stressors including, pests, pathogens, exotic species, and browse by ungulates. | o Are plant communities changing?<br>o Is plant community structure changing?<br>o Which key terrestrial pests and pathogens are present in Great Lakes national parks and at what abundance?<br>o To what degree is deer browse evident on terrestrial vegetation?<br>o Are Great Lakes Network forests exhibiting natural successional trajectories?<br>o Are the depths of soil horizons changing at sites, between sampling events? |
| Landbirds | • Bird Communities | Monitor landbirds each spring as an index to their abundance in parks of the Great Lakes Network, using methods that are comparable to other landbird monitoring across the region and the nation. | o What is the composition and relative abundance of landbirds along selected transects in the parks during the breeding season?<br>o What are the habitat associations of landbird species?<br>o What are the long-term trends in indices of landbird populations?<br>o How do population indices and habitat associations in the parks compare to other monitoring programs in the region? |

**Table 5.2.** Protocol objectives and monitoring questions, continued.

| Protocol | Vital Sign(s) | Objective | Monitoring Questions |
|---|---|---|---|
| Bioaccumulative Contaminants | • Trophic Bioaccumulation | Provide managers with knowledge on the trends and ecological effects of targeted, human-made toxic chemicals that are known to bioaccumulate in aquatic ecosystems of park units in the Great Lakes Network. | o What is the magnitude and direction of change in concentrations of select contaminants that bioaccumulate in tissues of indicator species?<br>o Is the reproductive success of target species changing and is it associated with contaminants?<br>o Are deformities evident in individuals from target populations and are they associated with contaminants? |
| Amphibians | • Amphibians and Reptiles | Provide information on occupancy, distribution, and relative abundance for a suite of amphibians that are integrators of environmental stressors in aquatic and terrestrial systems | o Are there within or among-park trends in occupancy of targeted species?<br>o Are occupancy trends associated with environmental variables or other GLKN Vital Signs? In particular, are species' distributions changing northward or closer to large water bodies in concert with longer-term climatic changes?<br>o How does the magnitude and direction of change in species occupancy compare regionally or nationally?<br>o How does detectability vary among observers, park units, years, and species?<br>o What is the relative abundance of targeted species at each site? |